

COMPAQ

Compaq AlphaServer DS10L Systems

Technical Summary



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Compaq AlphaServer DS10L Systems

The Compaq AlphaServer DS10L system is an entry-level system offering 64-bit computing with the Alpha processor. This single processor system is ideal for ISP/Internet applications, telecom applications, software development, and replicated site applications. The 1-U system box can be used on a desktop, or up to 40 can be mounted in a cabinet.

System Overview

The Compaq AlphaServer DS10L systems are now available with the 600 MHz Alpha chip, the 21264A (marketed as 600 MHz but it actually runs at 616 MHz). Systems with the 466 MHz 21264 Alpha chip are also being offered. Memory begins at 256 Mbytes and can be increased to 1 Gbyte. Second-level cache is 2 Mbytes. The switch-based system interconnect exploits the full potential of the Alpha chip.

The system measures 17.6 x 20.5 x 1.75 inches (1U) and can be placed on a desktop or rackmounted in a choice of three M-series cabinets, along with additional disks. In the largest cabinet (79 inches) up to 40 systems can be installed, or if more storage is desired, there can be up to three StorageWorks shelves and up to 25 to 28 systems. A rackmount slide kit is mandatory with each system in a cabinet.

Two drive bays are available for storage devices. One bay is used for the system disk, and the second bay can be used for either a second drive or an optional CD-ROM/floppy combination. Systems do not automatically include a CD-ROM and floppy. With a maximum of two 1-inch SCSI disks, there can be 72 GB storage in the system box.

There is one full-length, 64-bit PCI slot. Integrated on the system board are two 10/100 Mbit fast Ethernet controllers, an IDE controller, two serial ports, one parallel port, remote management console, and keyboard and mouse ports.

Systems can be purchased with the *Tru64 UNIX* or *OpenVMS* operating systems installed. Or they can be purchased without any operating system, allowing customers to install Linux.

Compaq AlphaServer products use the 64-bit Alpha RISC architecture that supports multiple operating systems: *Tru64 UNIX*, *OpenVMS*, and *Linux*.

For more information on Compaq AlphaServer DS10L systems, see

<http://www.compaq.com/alphaserver/servers.html>

Features and Benefits

- Performance**

The Alpha chip, the world's fastest microprocessor, is offered with a switch-based interconnect that supports one processor (466 MHz or 600 MHz) and up to 1 Gbyte of memory. This switch-based system provides a memory bandwidth of up to 1.3 Gbytes/sec (peak) using a 128-bit memory bus running at 77 MHz. The peak I/O bandwidth is 250 Mbytes/sec.

- Multiple Operating Systems**

No other server offers the flexibility of running so many operating systems: *Tru64 UNIX*, *OpenVMS*, and *Linux*. It's ideal as a development tool as well as a Web server or file server, or for remote applications or E-commerce applications.

- Package and Price**

All the features of *AlphaServers* are now available in a package that goes anywhere at a price attractive to everyone. Start with one and then add to your base as your needs demand. Use the DS10L as a dedicated system or set up a networked cluster.

Third-Generation Alpha Chip

The third generation of the Alpha microprocessor, the Alpha 21264, is a superscalar, superpipelined implementation of the Alpha architecture. The first offering of this chip, which was manufactured using the CMOS-6 process, was known as EV6 and now the EV67 (21264A) chip is available, which uses the CMOS-7 process. Over 15.2 million transistors are on one die.

In our discussion here, the Alpha 21264 designation applies to the EV6 and the EV67 chips, unless we need to distinguish between the two. Designed for performance, the Alpha 21264 achieves this goal by carefully studied and simulated architectural and circuit analysis. The 21264 memory system also enables the high performance levels. On-chip and off-chip caches provide for very low latency data access, which allows for very high bandwidth data access. The 21264 2-Mbyte off-chip cache runs at 186 MHz; the 21264A 2-Mbyte off-chip cache runs at 205 MHz.

Internal to each chip is a 64-Kbyte instruction cache (I-cache) and a 64-Kbyte data cache (D-cache).

- **I-cache.** 64 Kbytes, two-way set-associative, virtually addressed cache with 64-byte blocks
- **D-cache.** 64 Kbytes, two-way set-associative, virtually indexed, physically tagged, writeback cache with 64-byte blocks

Chip Operation

Several key design choices were made in the chip architecture to maximize performance: Four instructions are fetched each cycle, and then how those instructions are handled boosts the speed of execution. Register renaming assigns a unique storage location with each write reference to a register, avoiding register dependencies that can be a potential bottleneck to processor performance.

Another design feature, out-of-order execution, permits instructions to execute in an order different from the order that the instructions are fetched. In effect, instructions execute as soon as possible. This allows for faster execution since critical path computations are started and completed as soon as possible.

In addition, the Alpha 21264 employs speculative execution to maximize performance. It speculatively fetches and executes instructions even though it may not know immediately whether the instruction will be on the final execution path. This is particularly useful, for instance, when the 21264 predicts branch directions and speculatively executes down the predicted path. The sophisticated branch prediction in the 21264 coupled with the speculative and dynamic execution extracts the most instruction parallelism from applications.

For more information about the chip, see:

<http://www.compaq.com/alphaserver/download/ev6chip.pdf>

Alpha 21264 Features

- Out-of-order instruction execution
- Large (64 Kbyte) on-chip data and instruction caches
- Improved branch prediction through intuitive execution
- Register renaming
- Increased bandwidth for high-speed access to second-level cache and system memory
- Motion video instructions
- Square root and divide instructions
- All instructions are 32 bits long and have a regular instruction format
- Floating-point unit, supports DIGITAL and IEEE floating-point data types
- 80 integer registers, 64 bits wide
- 72 floating-point registers, 64 bits wide

Architecture

The traditional bus interconnect has been replaced by a switch-based interconnect system. With a bus design, the processors, memory, and I/O modules share the bus. As the number of bus users increases, the transactions interfere with one another, increasing latency and decreasing aggregate bandwidth. However, with a switch-based system there is no degradation in performance as the number of CPUs, memory, and I/O users increase. Although the users increase, the speed is maintained.

With a switch-based, or point-to-point interconnect, the performance remains constant, even though the number of transactions multiplies. The switched system interconnect uses a set of complex chips that route the traffic over multiple paths.

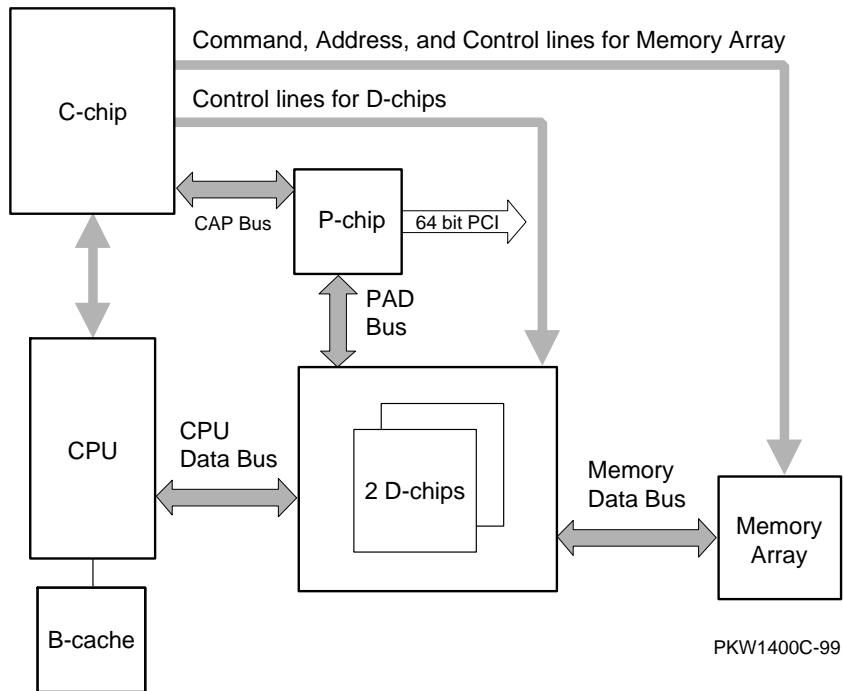
The chipset consists of one C-chip, one P-chip, and two D-chips.

- **C-chip.** Provides the command interface from the CPU.
- **D-chips.** Provide the data path for the CPU, main memory, and I/O.
- **P-chip.** Provides the interface to the PCI bus.

This chipset, similar to those used in the *AlphaServer DS20E* and *ES40* systems, supports up to one CPU and up to 1 Gbyte memory.

The PAD bus, the interface between the P-chip and the D-chips, is 32 data bits with 4 check bits. The 128-bit memory bus supports one memory array, yielding a 1.3 Gbyte/sec system bandwidth. Transactions are ECC protected. Upon the receipt of data, the receiver checks for data integrity and corrects any errors.

System Block Diagram



System Board

The interconnect switch is implemented on the system board by the chipset consisting of one C-chip, one P-chip, and two D-chips. The chipset provides the data and address path between the CPU, memory, and the I/O subsystem.

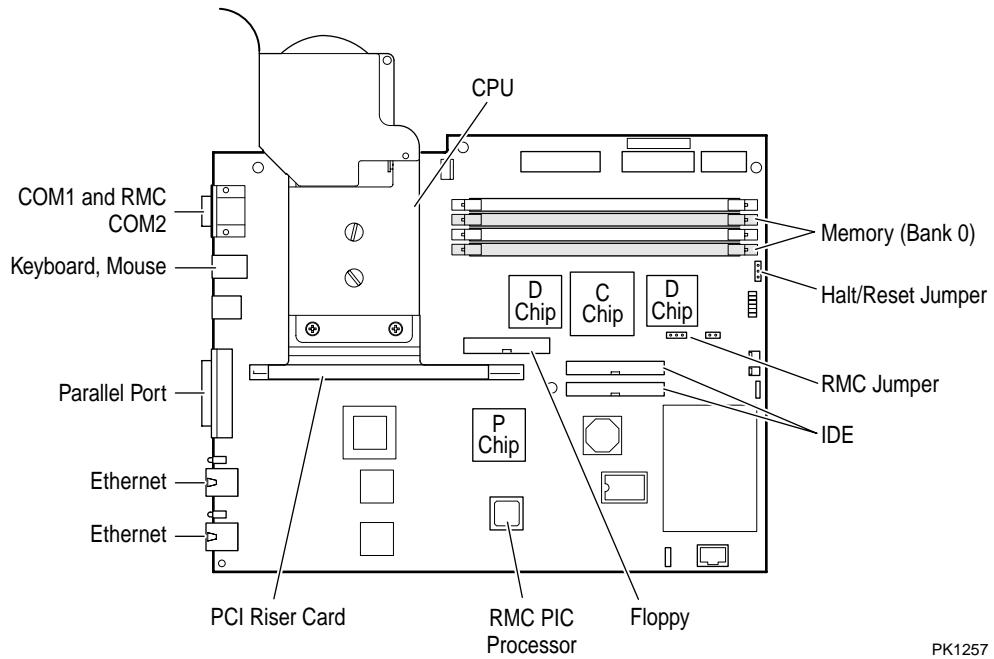
The CPU installed on the system board is either the Alpha 21264 (466 MHz) or the Alpha 21264A (600 MHz). The four cache chips provide 2 Mbytes of second-level cache. A flash ROM holds the SRM console code and the NVRAM data. The remote management console (RMC) is implemented by the RMC processor and is accessed through the COM1 port.

Integrated into the system board is the logic needed for all the ports shown on the left side of the module, including the two Ethernet ports, and also for the two IDE connectors.

Jumpers on the board allow you to change the action of the Halt button and disable the RMC timer.

Connectors are on the system board for the PCI riser card and two memory DIMMs.

Component and Connector Locations



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Memory

Memory throughput is maximized by the following features:

- 128-bit wide memory data bus
- Very low memory latency (120 ns) and high bandwidth with 12 ns clock
- ECC memory

The switch interconnect can move a large amount of data over the memory data bus. The data bus is 128 bits wide (16 bytes). With the memory bus speed of 77 MHz, the maximum bandwidth is 1.3 Gbytes/sec.

Memory Options

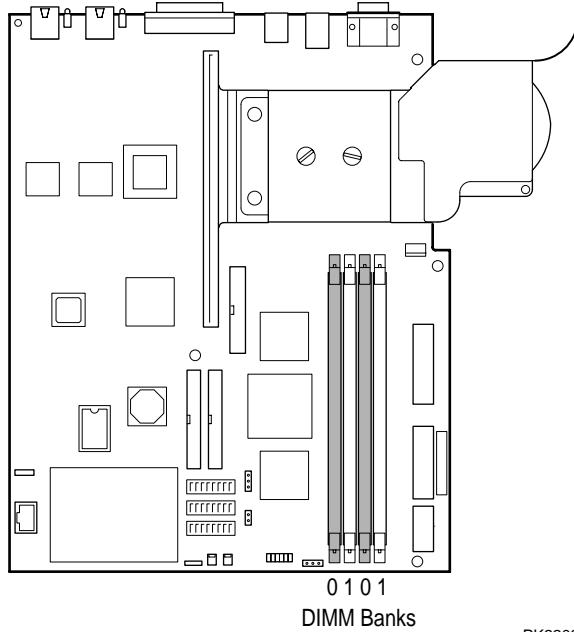
Each memory option consists of two 200-pin industry-standard DIMMs. Only one memory bank is used in DS10L systems. Systems ship with the memory ordered on the initial system sale. To increase memory, order new DIMMS and replace the existing ones with the new. The DIMMs are synchronous DRAMs. Memory options are available in the following sizes:

- 256 Mbytes (128 MB DIMMs)
- 512 Mbytes (256 MB DIMMs)
- 1 Gbyte (512 MB DIMMs)

The system supports 1 Gbyte of memory. With one memory option (2 DIMMs), memory operation interleaving will not occur.

Memory Configuration

- Systems come with one memory option (two DIMMs) installed in Bank 0.



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System I/O

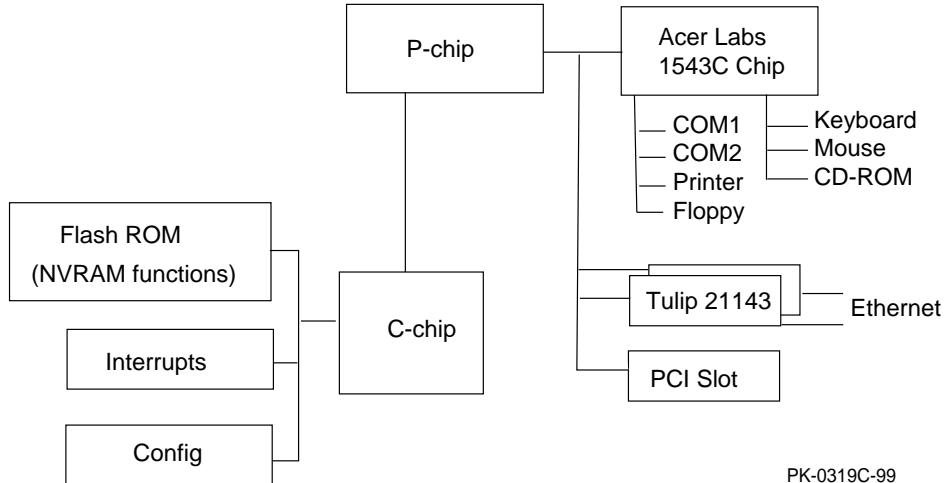
The industry-standard PCI bus is the number one choice for high-performance I/O options, such as disk storage and high-performance video applications.

- Supports three address spaces: PCI I/O, PCI memory, and PCI configuration space
- Supports byte/word, tri-byte, and longword operations
- Exists in noncached address space only

The PCI bus implementation has the following characteristics:

- Fully compliant with the PCI Version 2.1 Specification
- Operates at 31 MHz, delivering a peak bandwidth of 250 Mbytes/sec.

Block Diagram of I/O Control



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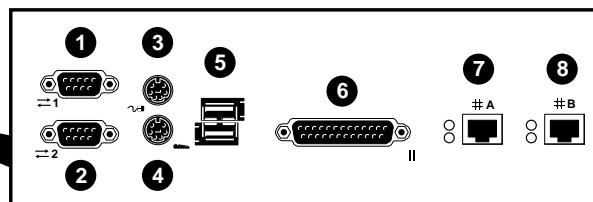
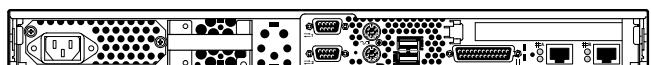
The industry-standard PCI I/O bus allows you to use inexpensive, widely available I/O options. Both 32-bit and 64-bit PCI options can be used; 3.3V and 5V options are supported.

The Acer Labs 1543C chip provides the bridge from the PCI to lower level bus functions. The C-chip controls accesses to memory on behalf of the P-chip. Two Tulip chips provide control for the two integrated Ethernet ports. On the PCI riser card is one 64-bit PCI slot.

I/O Ports

At the rear of the system are connectors offering access to two serial communication ports, one parallel port, two Ethernet ports, and ports for the keyboard and mouse. (The USB ports are not supported.) The COM1 port is used for the system console and for the remote management console.

I/O PORTS



1. COM1 and RMC port
2. COM2 port
3. Mouse
4. Keyboard
5. USB ports (not supported)
6. Parallel port
7. Ethernet A
8. Ethernet B

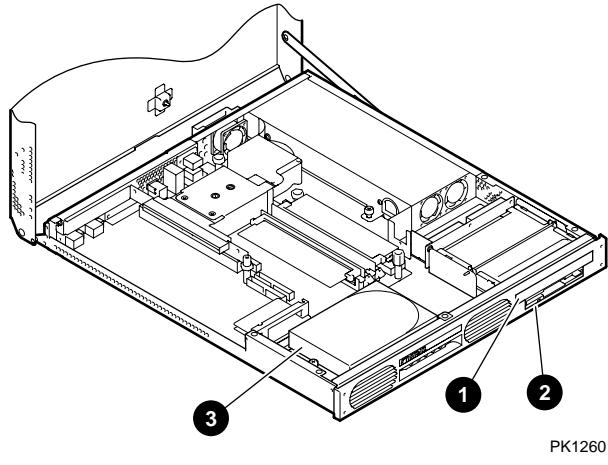
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Storage

The DS10L system has two drive bays. The system disk takes one, and the second bay can be used as either an additional disk or for the optional CD-ROM/floppy combo.

Disk supported are 10, 27, and 30 GB IDE disks and 9.1, 18.2, and 36.4 GB UltraSCSI disks (the UltraSCSI disks are 10,000 rpm).

Location	Description
①	CD-ROM
②	Floppy
③	System disk



RAID (Redundant Array of Independent Disks)

The system can be configured with optional PCI RAID controllers to organize disk data cost-effectively, improve performance, and provide high levels of storage integrity. Today, RAID is only available with external storage.

The optional RAID controllers have the following features:

- Support for hot-swap drives
- Automatic rebuild after hot swap
- Console support for booting system from RAID
- RAID levels 0, 1, 0+1, 5
- Optional write cache
- Optional read cache
- Support for command queuing

System Control

Close monitoring and control of the system environment and hardware is done by the remote management console (RMC). This logic allows the system operator to perform console operations remotely using a dial-in modem. The RMC logic is implemented using a PIC17C44 microprocessor on the system board. The RMC firmware code resides on the microprocessor and in flash memory. The RMC is powered by an auxiliary 5V supply, so even when the system is powered off at the control panel the RMC can be accessed—so long as the system is plugged in.

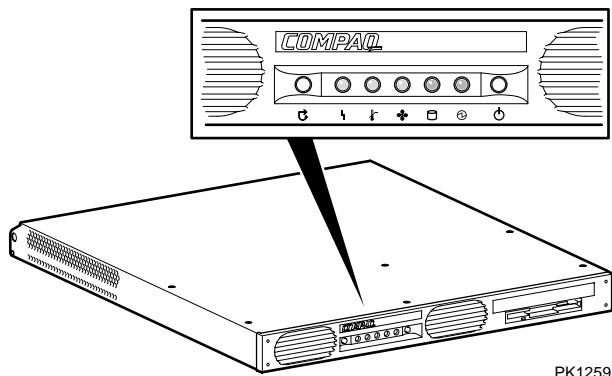
The RMC provides the following monitoring and control functions:

- Monitors thermal sensors, the power supply, and fans
- Detects alert conditions such as excessive temperature, fan failure, and power supply failure and sends an alert
- Performs remote power on/off, halt, and reset
- Dials a pager phone number or another computer system to notify the remote operator of an alert condition
- Shuts down the system if any fatal conditions exist

Upon an environmental event, the reason for failure is stored in the RMC NVRAM; the data can be retrieved to aid in diagnosing the problem.

Control Panel

The system control buttons and indicator LEDs are located on the front of the system.



The operation of the button at the left depends upon the setting of a jumper. It functions as a Halt button with *Tru64 UNIX* and *OpenVMS*.

Server Management

The *AlphaServer* products support important operational and platform management requirements.

Operational Management

Server/Network Management. *Compaq Insight Manager* is included with every system. This software tool allows you to monitor and control Alpha based servers. *Insight Manager* consists of two components: a Windows-based console application and server- or client-based management data collection agents. Management agents monitor over 1,000 management parameters. Key subsystems are instrumented to make health, configuration, and performance data available to the agent software. The agents act upon that data, by initiating alarms in the event of faults and by providing updated management information, such as network interface or storage subsystem performance statistics.

Remote Server Management. The integrated remote management console (RMC) lets the operator perform several tasks from a serial console: monitor the system power, temperature, and fans, and reset, halt, and power the system on or off. The monitoring can be done locally or remotely through a modem.

Platform Management

The *AlphaServer DS10L* systems support platform management tasks such as manipulating and monitoring hardware performance, configuration, and errors. For example, the operating systems provide a number of tools to characterize system performance and display errors logged in the system error log file.

In addition, system console firmware provides hardware configuration tools and diagnostics to facilitate quick hardware installation and troubleshooting. The system operator can use simple console commands to show the system configuration, devices, boot and operational flags, and recorded errors. Also, the console provides inventory support and configuration management by giving access to serial numbers and revisions of hardware and firmware.

Error Reporting

Compaq Analyze, a diagnostic service tool used to determine the cause of hardware failures, is installed with the operating systems. It provides automatic background analysis, as it constantly views and reads the error log file. It analyzes both single error/fault events and multiple events. When an error condition is detected, it collects the error information and sends it and an analysis to the user. The tool requires a graphics monitor for its output display.

Security

- Password protection is offered by the SRM console and RMC.

Reliability and Availability Features

The *AlphaServer DS10L* system achieves an unparalleled level of reliability and availability through the careful application of technologies that balance redundancy, error correction, and fault management. Reliability and availability features are built into the CPU, memory, and I/O, and implemented at the system level.

Processor Features

- CPU data cache provides error correction code (ECC) protection.
- Parity protection on CPU cache tag store.
- Multi-tiered power-up diagnostics to verify the functionality of the hardware.

Memory Features

- The memory ECC scheme is designed to provide maximum protection for user data. The memory scheme corrects single-bit errors and detects double-bit errors and total DRAM failure.

I/O Features

- ECC protection on the switch interconnect and parity protection on the PCI and SCSI buses.
- Extensive error correction built into disk drives.
- Optional internal RAID improves reliability and data security.

System Features

Auto reboot. On systems running *Tru64 UNIX* or *OpenVMS*, a firmware environment variable lets you set the default action the system takes on power-up, reset, or after an operating system crash. For maximum system availability, the variable can be set to cause the system to automatically reboot the operating system after most system failures.

Software installation. The operating systems are factory installed. Factory installed software (FIS) allows you to boot and use your system in a shorter time than if you install the software from a distribution kit.

Diagnostics. During the power-up process, diagnostics are run to achieve several goals:

- Provide a robust hardware platform for the operating system by ensuring that any faulty hardware does not participate in the operating system session. This maximizes system uptime by reducing the risk of system failure.
- Enable efficient, timely repair.

Audible beep codes report the status of diagnostic testing. The system has a firmware update utility (LFU) that provides update capability for console and PCI I/O adapter firmware. A fail-safe loader provides a means of reloading the console in the event of corrupted firmware.

Thermal management. The air temperature and fan operation are monitored to protect against overheating and possible hardware destruction. Seven fans provide cooling, two of which are in the power supply. If the temperature rises, the system fans speed up; or if necessary to prevent damage, the system shuts down.

Error handling. Parity and other error conditions are detected on the PCI bus. The memory checking scheme corrects single-bit errors and detects double-bit errors. Multiple ECC corrections to single-bit errors detected by the operating systems help in determining where in the system the error originated. Errors are logged for analysis.

Uninterruptible power supply. An external UPS can be purchased to support critical customer configurations. Because power is maintained for the entire system (CPU, memory, and I/O), power interruptions are completely transparent to users.

Clustering

A cluster is a loosely coupled set of systems that behaves (is addressed and managed) like a single system, but provides high levels of availability through redundant CPUs, storage, and data paths. Clusters are also highly scalable; that is, CPU, I/O, storage, and application resources can be added incrementally to efficiently increase capacity. For customers, this translates to reliable access to system resources and data, and investment protection of both hardware and software.

Clustering allows multiple computer systems to communicate over a common interface, share disks, and spread the computing load across multiple CPUs.

Operating System Support

OpenVMS cluster systems use the CI, SCSI, Ethernet, and FDDI as the interconnect between disks and the system.

The primary means of clustering *AlphaServer DS10L* systems depends on the operating system.

- Ethernet, *OpenVMS*
- CI clusters, *OpenVMS* only
- SCSI clusters, *Tru64 UNIX* and *OpenVMS*

Performance

Compaq has an ongoing program of performance engineering, using industry-standard benchmarks that allow comparisons across major vendors' systems. These benchmarks against competitive systems are based on comparable CPU performance, coupled with comparable memory and disk expandability.

See Table 1 for the performance numbers of the *AlphaServer DS10L* systems. System performance, however, is highly dependent upon application characteristics. Thus, benchmark information is one helpful "data point" to be used in conjunction with other purchase criteria such as features, service, and price.

Sources of Performance Information

Performance information is available on the Internet.

<http://www.compaq.com/alphaserver/performance/index.html>

http://www.ideasinternational.com/benchmark/spec/specfp_s2000.html

Information for Compaq Partners

If you are a Channel or Reseller Partner, you can find the tools, resources, and information you need to conduct Compaq business online on the secure Compaq Partner Network extranet site:
<http://CPN.compaq.com>

Also see the Compaq Solutions Alliance site at

<http://csa.compaq.com>

Service and Support

Compaq provides a comprehensive set of services that range from migration, consulting, and training, to direct support of Alpha systems, software, and applications. For information on Compaq Services, point your Web browser to <http://www.compaq.com/services>.

Hardware Warranty

The *AlphaServer DS10L* system and components, including CPU, memory, PCI controllers, and power supplies, have a 1-year on-site, 5-day per week, 9-hour per day hardware warranty with next business day response time.

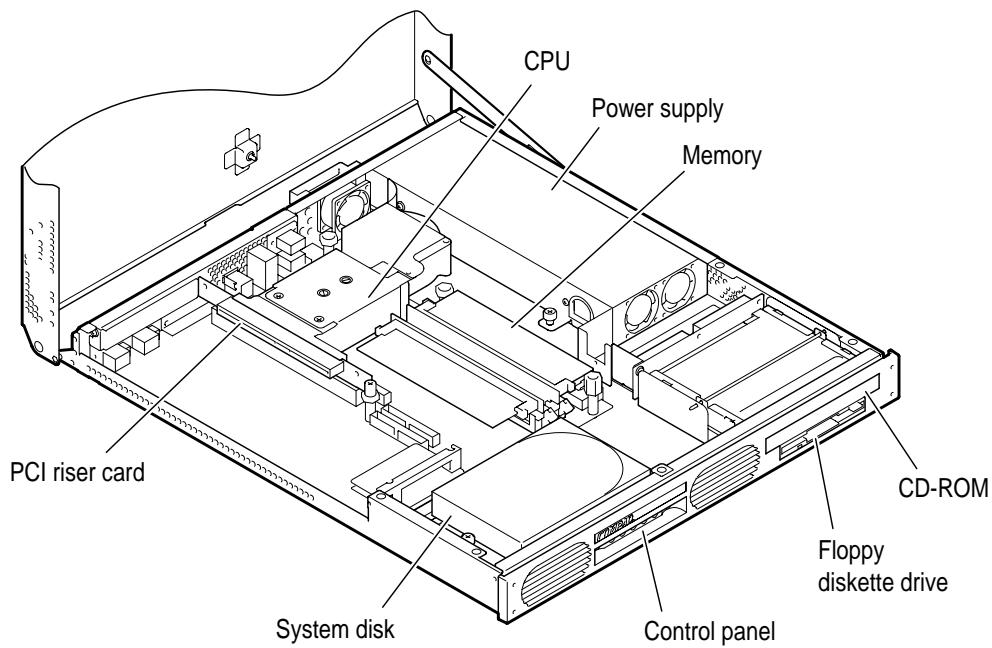
StorageWorks components are supported by the comprehensive StorageWorks warranty: five years for disks, three years for controllers, two years for tape devices, and one year for other components. The first year includes on-site next-day response time. Network products carry the network products warranty.

Users can upgrade to higher levels of service through a variety of hardware supplemental services.

Software Warranty

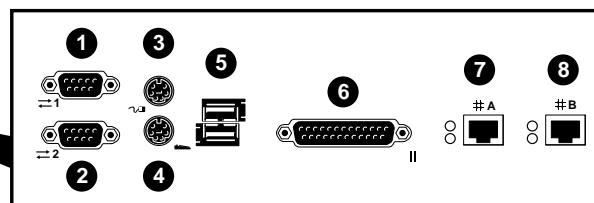
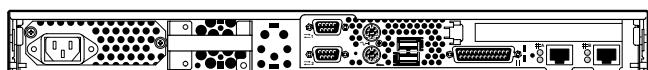
The warranty for *Tru64 UNIX* and *OpenVMS* is conformance to SPD with advisory telephone support for a period of 90 days. Users can upgrade to higher levels of service through a variety of software supplemental services.

Compaq AlphaServer DS10L System Diagrams



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I/O PORTS



- | | |
|----------------------|------------------------------|
| 1. COM1 and RMC port | 5. USB ports (not supported) |
| 2. COM2 port | 6. Parallel port |
| 3. Mouse | 7. Ethernet A |
| 4. Keyboard | 8. Ethernet B |

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System Features at a Glance

Table 1 provides a quick reference to features of the *Compaq AlphaServer DS10L* systems.

Table 1 AlphaServer DS10L Features

CPU Features	6/466	67/600
Processor	One Alpha 21264	One Alpha 21264A
CPU clock speed	466 MHz	600 MHz (actually 616 MHz)
Cache on chip	64 KB I-cache 64 KB D-cache	64 KB I-cache 64 KB D-cache
On-board cache	2 MB	2 MB
Memory (maximum)	1 GB	1 GB
Performance	6/466	67/600
SPECint2000	—	364
SPECfp2000	—	411
SPECint95	24.6	35.3
SPECfp95	47.9	56.1
SPECint_rate95	222	319
SPECfp_rate95	431	505
Linpack 100x100	—	483.4
Linpack (1kx1k)	—	900.9
Standard Features	10/100 Mbit Ethernet ports, IDE controller, 2 serial ports, 1 parallel port, keyboard and mouse, integrated remote management console, operating system license and customer documentation, Internet software	
Internal Storage		
Removable media	Optional CD-ROM/floppy drive combo	
Max. system storage	36 GB (2 SCSI disks)	
I/O System		
I/O slots	1 full-length 64-bit PCI slot	
Maximum PCI throughput	250 MB/sec	
High Availability Features		
System	Auto reboot, thermal management, remote management console, RAID, ECC memory, ECC cache, error logging, optional uninterruptible power supply. Also with rackmount: multiple systems, multiple power sources, dual-ported storage	
OpenVMS clusters	Ethernet, DSSI, SCSI, and FDDI	
Operating Systems	<i>Tru64 UNIX, OpenVMS, and Linux</i>	
Warranty		
Hardware	1-year, on-site, 5 day x 9 hour warranty with next business day response	
Software	90-day telephone advisory support for <i>OpenVMS</i> and <i>Tru64 UNIX</i>	

Physical Characteristics

Table 2 details basic physical characteristics of the system.

Table 2 AlphaServer DS10L Physical Characteristics

Dimensions		
Height	4.3 cm (1.75 in.)	
Width	44.6 cm (17.6 in.)	
Depth	52 cm (20.5 in.)	
Weight	9.4 kg (22 lb)	
Environmental		
Temperature	Operating Nonoperating (storage) Nonoperating (transport)	10 – 35° C (50 – 95° F) 5 – 50° C (41 – 122° F) –40 – 66° C (–40 – 151° F)
Humidity (noncondensing)	Operating Nonoperating (storage) Nonoperating (transport)	10 – 90% RH (maximum wetbulb: 28° C) 10 – 95% RH (maximum wetbulb: 32° C) 10 – 95% RH (maximum wetbulb: 46° C)
Maximum altitude (unpressurized)	Operating Nonoperating	3,048 m (10,000 ft) 12,192 m (40,000 ft)
Shock	Operating	10 G, 10ms half-sine
Vibration	Operating	5 to 500 Hz at 0.1 G sine, 0.02" (0.5 mm) maximum displacement
Electrical		
Nominal voltage range (Vac)	100–120/220–240	
Operating voltage range (Vac)	90–128/180–265	
Power source phase	Single/Single	
Nominal frequency (Hz)	60/50	
Frequency range (Hz)	59–61/49–51	
Maximum inrush current (amps)	22/11	
Single power supply (amps)	12/5	
Acoustics—Declared values per ISO 9296 and ISO 7779		
Current values for specific configurations are available from Compaq. 1 B = 10 dBA		
Acoustics		
Idle	L _{WAd} , B 6.0	L _{pAm} , dBA (bystander position) 46
Operating	6.1	47



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